INVENTORIES OF SPENT FUEL (Map Activity)

Purpose:

This lesson will enable students to determine which States currently have inventories of spent fuel. Additionally, a spatial perspective will be created that will accentuate the extent of the accumulation of spent fuel in the United States.

Concepts:

1. A national challenge exists because there is an accumulation of spent fuel.
2. Spent fuel is currently stored in 35 States.

Duration of Lesson:

Two 50-minute class periods

Objectives:

As a result of participation in this lesson, the learner will be able to:

1. construct a choropleth map showing geographic distribution of inventories of spent fuel by volume and
2. analyze the patterns of distribution of spent fuel in the United States.

Skills:

Analyzing, critical thinking, data transferring, developing a frequency diagram, discussing, grouping, labeling, mapping, sorting

Vocabulary:

Choropleth map, cubic meter, frequency diagram, geographic distribution, inventory, spatial, thematic map

Materials:

Activity sheets
- *Inventories of Spent Fuel*
- *Spent Fuel Inventories Number Line*
- *1993 Inventories of Spent Fuel by State* (blank U.S. map)

U.S. Map or Atlas (Optional for State abbreviations)
Colored pencils (Optional)

Suggested procedure:

A thematic map is about a single topic, such as inventories of spent fuel. Thematic maps with shaded or colored areas are choropleth maps. Their shading or coloring enables map readers to see patterns quickly, and for this reason, shading or coloring is progressively darker as data values increase.

The spent fuel inventory data can be visualized in two ways: 1) arranging data on the provided number line (also called a frequency diagram) and 2) filling in the map according to the volume ranges specified by the legend. In this lesson students will fill in the number line and the choropleth map for inventories of spent fuel using data taken from the table entitled *Spent Nuclear Fuel*, which appears on the enrichment activity sheet entitled *Spent Fuel Inventories Number Line*. Have the students fill in the number line first. The number line can be used to explain how the map legend was developed, or as an easy way to retrieve data when coloring the map.

An answer map is included in this enrichment activity.

1. Assign the enrichment activity entitled *Inventories of Spent Fuel*. The activity can be either an individual or group activity. To complete the activity, students will need copies of *Spent Fuel Inventories Number Line* and *1993 Inventories of Spent Fuel by State* (a blank U.S. map).

2. You may wish to begin by discussing the activity introduction, which describes thematic and choropleth maps and identifies for students the two ways they will view the data in this assignment: arranging data into prescribed categories on the number line and filling in a map according to the given legend.

3. Have students fill in the number line. Depending on the students, you may want to discuss where the number breaks could fall in order to have a nicely distributed map. Show them or tell them where to put the arrow marks so as to agree with the map.

Students should be able to complete the activity by following the directions on the activity sheet. Students should understand that the categories do not have to represent equal numbers on the number line or equal numbers of States. The goal is to establish categories that will show map readers a pattern.

The following questions may be helpful in discussing why the categories were developed as they were.

a) The States with spent fuel storage were divided into five categories. If only two categories were selected, what would the map show?

(Probably, only the States that have spent fuel and the ones that do not. With only two categories, a range cannot be shown.)

b) What additional information will the map reader gain from the map showing five categories of spent fuel inventories?

(The map reader will picture the range of spent fuel inventories.)

c) How should States with no stored spent fuel be shown on the map?

(There should be a sixth category in the legend for zero – those States with no inventory of spent fuel.)

d) On the number line, which categories have four or more States listed?

(1-300, 301-900, 901-1,500)

e) Which State has almost double the spent fuel of its closest counterpart?

(Illinois)

4. Selecting symbols or colors:

One purpose of a choropleth map is to enable the map reader to see patterns quickly. Symbols or colors selected should reinforce visually the range of data values, with darker symbols or colors representing greater values. Some groups, or individuals, may need some help in thinking of symbols or in establishing a range of colors.

5. Have students label States and fill in the key and map with the colors or symbols they chose. Remind them that they can look off the number line they made or the table in section 1.14 Spent Fuel Storage.

6. The discussion questions below may be used to analyze patterns of distribution of spent fuel in the United States.

a. In how many States was spent fuel being stored in 1993? *(35)*
What percent of the States? *(70%)*

In what region of the United States is spent fuel storage concentrated?

(East of the Mississippi River)

b. How many States had no spent fuel stored in 1993? *(15)*
What percent of the States? *(30%)*

In what region of the United States are most of these States located?

(West of the Mississippi River)

c. Are there clusters of States with high inventories of spent fuel?

(A cluster of southeastern States and a cluster of middle Atlantic States have higher inventories of spent fuel.)

d. As you look at the map, do you see any relationship between population and inventories of spent fuel?

(The concentration of spent fuel is in the Eastern States where the greatest concentration of U.S. population is located.)

Is this what you would expect? Why or why not?

(Spent fuel is linked to use of electricity from nuclear powerplants. Where there are more people, there is generally more use of electricity so this is not unexpected.)

e. As you look at the map, do you see any relationship between States with inventories of spent fuel and States that are known for industrial output as opposed to ranching, mining, etc.?

(Most students will see that the greatest concentration of spent fuel is in the States east of the Mississippi and identify this region as being more industrial than the western States that have no spent fuel.)

Is this what you would expect? Why or why not?

(Spent fuel is linked to use of electricity from nuclear powerplants. Because industry generally requires electricity, this is not unexpected.)

f. The goal of an electric utility company is to provide least-cost and reliable supplies of electricity to customers. What factors do you think a utility considers when deciding what type of powerplant to build?

(A variety of factors influence the selection of technology and fuel, including the cost associated with construction, borrowing the money to finance building, etc. (i.e., capital costs); operation and maintenance costs; environmental restrictions on the technology and use of the fuel; regulations affecting fuel use; cost and availability of fuel; availability of capacity associated with the type of fuel.)

g. As you look at the map, do you see any link between State or regional natural resources related to generating electricity and the presence of spent fuel in States?

(The energy source used to generate electricity in any State or region is determined at least in part by the natural resources of the State or geographic region. For example, east of the Mississippi, only five States do not have an inventory of spent fuel. Two of those are Kentucky and West Virginia, which are both coal-producing States. In some western States, where rivers were available to build dams, hydropower produces a high percentage of electricity.)

h. Do the factors of population, industry, and natural resources apply to the presence or absence of spent fuel in the State you live in? The region you live in?

(Answers will vary.)

Teacher Evaluation of Learner Performance:

Completion of the number line, activity map, and participation in discussion will indicate comprehension.